REMARKS

This is in reply to the Office Action dated March 26, 2004. Applicant provides a basis for the newly submitted claim amendments wherein the newly introduced claim language is provided hereinbelow underlined followed by a basis for explanation for such amendment follows thereafter.

The limitation of "a metal selected from the group consisting of Ti, Zr, Sn and In"

In the third aspect of the present invention, they are exemplified as being preferable (see page 61, line 3-p. 62, line 10 of the specification).

Recitation of "a use of a photosensitive composition for volume hologram recording"

It is submitted that it is clear from the present specification that the photosensitive composition disclosed therein is used for volume hologram recording as the specification is replete with such references.

Recitation of "a method for preparing a volume hologram having a step of exposing a volume hologram recording material layer comprising a photosensitive composition" finds appropriate basis at p. 65, ln. 5 -pg. 66, ln. 14.

The language "a metal chelate compound containing a metal atom having higher refractive index than the photopolymerization reactive compound" has appropriate basis as a mechanism of volume hologram recording in the third aspect of the present invention, it is mentioned, "[A]s a result, regions where the photopolymerization reactive compound richly exists and regions where the binder polymer richly exists are made corresponding to the brightness and darkness of the interferential light, and this appears as the difference of the

refractive indices. In the present invention, a metal atom having a high refractive index has been introduced into the binder resin, it is possible to enlarge its difference of the refractive index comparing with the conventional organic material series." (see p. 66, lines 5-14)

It is clear that the metal chelate compound used in the third aspect of the present invention means a metal chelate compound containing has a higher refractive index relative to than the photopolymerization reactive compound.

A photosensitive composition and a photosensitive medium for volume hologram recording of the present invention is provided in amended claims 1 and 8 as provided. One feature of the present invention is the use of an organic-inorganic hybrid polymer having a metal component capable of performing hydrolysis and polycondensation on a principle chain of an organic polymer in a pendant shape and an organometallic compound represented by the general formula 2 capable of performing hydrolysis and polycondensation in combination. Hydrolysis and polycondensation can be performed between each metal. Thereby, the resultant film has a flexible portion and a durable portion in the chain, and a refractive index of the film obtained can be changed by incorporating the metal atom therein. That is, by using the organic-inorganic hybrid polymer and the organometallic compound represented by the general formula 2 in combination, it can significantly improve a film physical property in comparison to the instance of using the organometallic compound represented by the general formula 2 capable of performing hydrolysis and polycondensation, as it can increase the change in refractive index of the film itself in comparison to using the organic-inorganic hybrid polymer alone.

A surprising the technical advance is achieved when the photosensitive composition of the present invention and the photosensitive medium are used for volume hologram recording.

Firstly, the difference of refractive indices between a photopolymerization reactive compound, which diffuses and shifts, and a film itself can be enhanced. As a result, a refractive index modulation amount of an exposed region can be enlarged. Secondly, having a flexible portion and a durable portion in the chain, as a film physical property, the film obtained has the flexibility that the organic polymer has and the durability and the heat resistance of the inorganic polymer has in combination providing excellent processing properties. Moreover, the compatibility with a photopolymerization reactive compound is better or more enhanced when just an inorganic polymer, is utilized. The photosensitive composition for volume hologram recording is easily prepared to be a uniform coating liquid. Therefore, the present invention, as now claimed recites a photosensitive composition and a photosensitive medium, which is capable of realizing a large refractive index modulation amount and obtaining a volume hologram with excellent physical properties.

In paragraph 13 of the Action, Roos, U.S. Pat. No. 3,758,306 is cited giving rise to a rejection under 35 USC 102(b) to claims 1, 3-5, 7-8, 10-13, 15-17 and 19-23 as originally filed.

In support of the present invention as claimed, Applicant cites in the amended claim set provided Example 1 of the subject application wherein a photosensitive resin composition containing a terpolymer of γ-methacryloxypropyltrimethoxy silane, methyl methacrylate and methacrylonitrile, a trimethylolpropane triacrylate, a 2-o-chlorophenyl-4,5-bis(phenyl)imidazoyl-yl dimer, and a coumarin is mentioned, and it is also mentioned to provide a film thereof on a substrate is disclosed.

This feature is the result of using an organic-inorganic, hybrid polymer having a metal component capable of performing hydrolysis and polycondensation on a principle chain of an

organic polymer in a pendant shape and an organometallic compound represented by the general formula 2 capable of performing hydrolysis and polycondensation in combination. Hydrolysis and polycondensation can be performed between each metal as stated above. Thereby, the film obtained has a flexible portion and a rigid portion in the chain, and a refractive index of the film obtained itself can be changed by the incorporation of a metal atom so as to enlarge a refractive index modulation amount.

On the contrary, the Roos reference discloses an organic-inorganic hybrid polymer Example 1. The use of the organic-inorganic hybrid polymer and an organometallic compound represented by the general formula 2 of the instant invention, capable of performing hydrolysis and polycondensation in combination is not contemplated much less mentioned in Roos. On this point alone Applicant submits that the present invention is submitted to be patentably distinguishable over Roos.

Additionally, Roos discloses an organosilane in a composition for improved adhesion to a substrate and increased wettability (see col. 1, lines 12-16, col. 2, lines 58), thus, a further distinction is found in that the purpose of using the organic-inorganic hybrid polymer further differs from that of the present invention. In the present invention, an organic-inorganic hybrid polymer and an organic metal compound are used in combination in order to increase the refractive index modulation and to impart, as a film physical property, the flexibility, the rigidity and the heat resistance in combination. As the features giving rise to such properties are not disclosed by this reference, the effect cannot therefore be anticipated by Roos.

In paragraph 15 of the Action, the Examiner states that it would have been obvious to modify the process of Maeda et al. by using producing a reactive sol-gel matrix containing

epoxide moieties in view of the disclosure of Sato et al. It is stated that these would be compatible and that epoxide containing reactive binder are desirable in holographic recording media, using technique similar to those disclosed by Baney et al. and Krug et al. to form the epoxide containing polymerizable matrix.

Maeda et al., '771 discloses an optical holographic film using both an inorganic material network and a photopolymerizable monomer (see claim 1), and a sol-gel processing.

At column 6, lines 63-67 it is stated, "The silicon compound includes silanol-terminated polydialkylsiloxane, epoxysilane and aminosilane. The silicon compound bonds to the gel formed from the metal compound (C) to impart the gel with flexibility."

Sato et al, '846 discloses a composition for volume hologram comprising a cationic polymerizable compound, a radical polymerizable compound, a cationic polymerization initiating material and a radical polymerization initiating material, wherein at least one of the cationic polymerizable compound and the radical polymerizable compound has a siloxane group is disclosed. (see claim 1).

Sato et al. assumes that the refractive index modulation is improved since a compound having a siloxane group is liable to move in a hologram producing process (an interference exposure step) from the dark part to light part of the interference fringe, thereby increasing the degree of separation in concentration between them (see col. 8, lines 38-51).

The polymerizable compound having a siloxane group used in the Examples is disclosed as having a refractive index of 1.49 or less. It is further mentioned that a silane coupling agent

may be further contained as an optional additive at col. 7, line 11 of Sato, however, the silane coupling agent is not disclosed in any of the Examples.

Also, it is mentioned that a polymer binder may also be contained as an optional additive. It is necessary for the polymer binder to have good compatibility with component (A), a polymerizable polymer. Although the polymer binder is mentioned that it may have a reactive group such as a cationic polymerizable group (col. 7, lines 15-24), in the Examples, a methyl methacrylate/ethyl acrylate/acrylic acid copolymer is used.

Baney et al., Chem. Rev. vol. 5 at pages 1409-1430 discloses techniques for forming organic/inorganic hybrid, including those containing moieties which may be photocured, such as epoxides and vinyl moieties.

Krug et al., J. non-cryst. Sol. Vol. 147/148 teaches the method for forming photocurable sol-gel polymers where methacrylate monomers are reacted with alkoxides and then with other monomers.

As mentioned above, a feature of the present invention, the changing of the refractive index can be achieved is by using an organic-inorganic hybrid polymer including a metal component capable of performing hydrolysis and polycondensation on a principle chain of an organic polymer in a pendant shape and an organometallic compound represented by the general formula 2 capable of performing hydrolysis and polycondensation in combination. The resultant film has a flexible portion and a rigid portion in the chain. Thereby, the film has the desired physical properties of flexibility imparted by the organic polymer, rigidity and heat resistance imparted by the inorganic polymer when used in combination thus achieving these excellent processing properties.

Maeda et al. only mentions that a network structure solely comprised of chains of mutually bonded inorganic compounds, and an organic group may be introduced as a side chain of the network structure of the inorganic network in a pendant shape. The Maeda reference mentions nothing about an organic-inorganic hybrid polymer having a metal content capable of performing hydrolysis and polycondensation on a principle chain of an organic polymer in a pendant shape. Hence, there is no mention of using the organic-inorganic hybrid polymer and the organometallic compound represented by the general formula 2 capable of performing hydrolysis and polycondensation in combination.

Further, since the network structure of Maeda is solely comprised of chains of mutually bonded inorganic compounds, the benefit of utilizing the organic-inorganic hybrid polymers is not experienced when the film is processed. This problem was both recognized and overcome by the inventors of the present invention by utilizing the organic-inorganic hybrid polymers. The Maeda reference does not recognize such a problem nor provide any solution.

Therefore, the effect of the present invention of using the organic-inorganic hybrid polymer and an organometallic compound capable of performing hydrolysis as well as polycondensation in combination, having a refractive index of a film obtained itself which can be changed and a film physical property such as flexibility and excellent properties is submitted to be novel and inobvious over this reference. Furthermore, the compatibility with a photopolymerization reactive compound and the photosensitive composition for volume hologram recording being easily prepared to be a uniform coating liquid so as to improve handling is simply not anticipated by Maeda et al.

Sato et al. does not mention the organic-inorganic hybrid polymer which is obtainable by copolymerizing an organometallic compound represented by the general formula 1 and a monomer having an ethylenically unsaturated bonding. Thus, there is no mention of using the organic-inorganic hybrid polymer in combination with the organic metal compound represented by the general formula 2 capable of performing hydrolysis and polycondensation.

Sato mentions that it is necessary for the polymer binder to have a good compatibility with a component (A) a polymerizable polymer, and that the polymer binder may have a reactive group such as a cationic polymerizable group. However, from this disclosure, it cannot be considered to be anticipatory to use the organic-inorganic hybrid polymer which is obtained by copolymerizing an organometallic compound represented by the general formula 1 and a monomer having an ethylenically unsaturated bonding such that, a film physical property, has the flexibility, that the organic polymer has including rigidity and heat resistance which results from the inorganic polymer used in combination so as to have an excellent processing properties.

On the other hand, as it is clear that the compound including a siloxane group is used as a refractive index modulation component (a photopolymerizable compound) for forming an interference fringe by changing the refractive index of a highly exposed region at the time of interference exposure. Since there is no disclosure containing a metal component in a binder polymer, it is submitted that the present invention differs from the reference and is patentabily distinguishable. Further, all polymerizable compounds having a siloxane group disclosed in the Examples have a low refractive index of 1.49 or less. This is similar to a methyl methacrylate/ethyl acrylate/acrylic acid copolymer used together as a binder polymer in the examples. Therefore there is no disclosure or suggestion to obtain a hologram having a large refractive index modulation amount in such a manner that the refractive index of the film

obtained is changed or affected by a metal atom incorporated in a binder resin to change the refractive indices with the photopolymerization reactive compound.

Therefore, the feature of the present invention including the use of the organic-inorganic hybrid polymer, the organometallic compound capable of performing hydrolysis and polycondensation in combination, improved physical film properties and a refractive index of the film obtained itself being changed by the incorporation of a metal atom to enlarge the difference of refractive index modulation with the photopolymerization reactive compound are simply not anticipated by Sato.

Applicant respectfully submits that it would have not been obvious to modify the process of Maeda et al. by using producing a reactive sol-gel matrix containing epoxide moieties based upon the disclosure of Sato et al. to be compatible and that epoxide containing reactive binder are desirable in holographic recording media to form the epoxide containing polymerizable matrix. However, the feature of the present invention is, as mentioned above, to use an organic-inorganic hybrid polymer having a metal component capable of performing hydrolysis and polycondensation on a principle chain of an organic polymer in a pendant shape and an organometallic compound represented by the general formula 2 capable of performing hydrolysis and polycondensation in combination.

As above described, the conception to have excellent processing properties by imparting the flexibility of the organic polymer and the rigidity and durability heat resistance imparted by the inorganic polymer in combination to provide the desired film physical properties cannot be anticipated by Sato et al. and Maeda et al.

Even if one of ordinary skill in the art viewed the disclosures of Baney et al. and Krug et al. into account, as for a photosensitive composition for volume hologram recording, together it is submitted that the presently claimed invention cannot be considered to be anticipated or obvious as there is no disclosure either explicitly explicit or implicit of a large refractive index modulation be achieved using the change of refractive index of a film obtained itself and obtain film physical property improvements by selecting an organic-inorganic hybrid polymer of the subject application which is obtained by copolymerizing an organometallic compound represented by the general formula 1 and a monomer having an ethylenically unsaturated bonding and further using the organic-inorganic hybrid polymer in combination with the organometallic compound represented by the general formula 2 capable of performing hydrolysis and polycondensation.

For the reasons mentioned above, the presently claimed invention as amended is submitted to not be obvious in view of these references. Accordingly, Applicant respectfully submits that the amended claimed invention has been patentably distinguished over the aforementioned references.

In further support of claims 13-24, Applicant states that the feature of providing a photosensitive composition and a photosensitive medium for volume hologram recording as defined in claims 13, 19 and 20 using an organic-inorganic hybrid polymer having a silicon compound capable of both hydrolysis and polycondensation on a principle chain of an organic polymer in a pendant shape and/or a hydrolyzed polycondensate of said organic-inorganic hybrid polymer in combination with an organometallic particle having a photopolymerization reactive group capable of exhibiting a refractive index different from that of a hydrolyzed polycondensate of said organic-inorganic hybrid polymer is not disclosed alone in any reference of record or by

combination if permissible. The organometallic particle of the present invention is a compound that at least one photopolymerization reactive functional group is bonded on the surface of the metallic particle (p. 49, lines 13-17). It is different from a coupling agent or polymers of coupling agents.

The photosensitive composition and photosensitive medium of the present invention as defined in claims 13, 19 and 20, include the organic-inorganic hybrid polymer having a silicon compound which functions as a binder component having low refractive index and capable of performing hydrolysis and polycondensation. Thus, a volume hologram having a large refractive index modulation amount between a binder and a refractive index modulation component can be obtained by selecting a metal of the organometallic particle, which is the photopolymerization reactive compound mentioned above and functions as a refractive index modulation component.

Further, since the organic-inorganic hybrid polymer is used as a binder polymer, the resultant film has a flexible portion and a rigid portion in the chain providing flexibility, durability and heat resistance. The inorganic polymer provides excellent processing properties. The dispersibility of the organometallic particle is excellent due to the inorganic portion of the hybrid polymer, and the photosensitive composition is easily prepared for use a uniform coating liquid due to the dispersibility of this particle.

Accordingly, the photosensitive composition and photosensitive medium provide a volume hologram capable of realizing a large refractive index modulation and excellent physical properties of the film are obtained.

In item no. 13, it is stated that "the terpolymer of methacryloxypropyltrimethoxy silane, methyl methacrylate and methacrylonitrile meets both the hybrid polymer and the organometallic

particle limitation. As polymerization was used to form the terpolymer, at least some of the groups would still be left on the polymer and it would be reactive and able to change its refractive index due to further curing by photopolymerization."

As discussed above, Roos '306 discloses γ-methacryloxypropyltrimethoxy silane as a terpolymer. However, γ-methacryloxypropyltrimethoxy silane is not an organometallic particle required by the present invention. The polymerized product of γ-methacryloxypropyltrimethoxy silane can not be the organometallic particle of the present invention or an equivalent thereof. Roos simply does not disclose the organometallic particle of the present invention or any organometallic. This reference does teach a volume hologram having a large refractive index modulation amount between a binder of a low refractive index and an organometallic particle by selecting a metal of the organometallic particle.

For all of these reasons, the present invention as amended is submitted not to be anticipated by Roos.

In item 15 of the Action, it is asserted that it would have been obvious to modify the process of Maeda et al. by using producing a reactive sol-gel matrix containing epoxide moieties in view of the disclosure of Sato et al. It is further stated that these references would be compatible and that epoxide containing reactive binder desired in holographic recording media, using technique are similar to those disclosed by Banyer et al. and Krug et al. to form the epoxide containing polymerizable matrix.

As mentioned above, the present invention provides an organic-inorganic hybrid polymer having a silicon compound and/or a hydrolyzed polycondensate of said organic-inorganic hybrid polymer is used in combination with an organometallic particle which has a photopolymerization

reactive group and is capable of exhibiting a refractive index different from that of the hydrolyzed polycondensate of said organic-inorganic hybrid polymer, a refractive index modulation amount between an organometallic particle which is photopolymerization reactive and a refractive index modulation component and a binder can be enlarged, a film obtained has a flexible portion and a tough portion in the chain and has excellent processing properties. Furthermore, the excellent dispersion properties of the organometallic particle due to the inorganic portion of the organic-inorganic hybrid polymer, and the photosensitive composition for volume hologram recording is easily prepared in a uniform coating liquid.

On the contrary, Maeda et al. only mentions that a network structure is solely comprised of chains of mutually bonded inorganic compounds, and that an organic group may be introduced as a side chain of the network structure of the inorganic network in a pendant shape. In Maeda et al., there is no disclosure of an organic-inorganic hybrid polymer having a metal component capable of performing hydrolysis and polycondensation on a principle chain of an organic polymer in a pendant shape.

Also, Maeda et al. does not disclose the organometallic particle of the present invention. Nor does this reference imply the use of the organometallic particle, which has a photopolymerization reactive compound as a refractive index modulation component and is capable of exhibiting a refractive index different from that of the hydrolyzed polycondensate of said organic-inorganic hybrid polymer.

Therefore, the effect exhibited by the present invention using the organic-inorganic hybrid polymer having a silicon compound used in combination with the organometallic particle having a photopolymerization reactive group wherein the refractive index modulation amount

can be enlarged is simply not disclosed. The resultant film having a flexible portion and a durable portion in the chain and having excellent processing properties is not achieved by this reference. Furthermore, the excellent dispersion property of the organometallic particle due to the inorganic portion of the organic-inorganic hybrid polymer and the photosensitive composition for volume hologram recording is easily prepared to be a uniform coating liquid. These features are not taught or contemplated by Maeda et al.

Similarly, Sato et al. does not mention the organic-inorganic hybrid polymer obtained by copolymerizing an organic silicon compound represented by the general formula 3 and a monomer having an ethylenically unsaturated bonding.

In fact, Sato et al. teaches that it is necessary for the polymer binder to have a good compatibility with a component (A) (a polymerizable polymer), and that the polymer binder may have a reactive group such as a cationic polymerizable group. However, these teachings fall short of disclosing the use the organic-inorganic hybrid polymer which is obtainable by copolymerizing the organometallic compound represented by the general formula 1 and the monomer having an ethylenically unsaturated bonding so that, as a film physical property, it has the flexibility that the organic polymer has and the durability and the heat resistance those the inorganic polymer has in combination so as to have an excellent processing properties.

Further, though the compound having a siloxane group is used as a refractive index modulation component (a photopolymerizable compound), it is different and distinguishable from the organometallic particle used in the present invention wherein at least one photopolymerization reactive functional group is bonded on the surface of the metallic particle. Sato et al. does not explicitly teach or imply the use of the organometallic particle, which has a

photopolymerization reactive compound capable of exhibiting a refractive index different from that of the hydrolyzed polycondensate of said organic-inorganic hybrid polymer.

Therefore, the effect of the present invention as discussed hereinabove is submitted not to be anticipated by Sato et al.

The conclusion that it would have been obvious to modify the process of Maeda et al. based upon the teaching of Sato et al to arrive what at Applicant's claimed invention is believed to overcome. The features of the present invention using the organic-inorganic hybrid polymer including a silicon compound capable of performing hydrolysis and polycondensation and the organometallic compound having a photopolymerization reactive group in combination is simply not met by these references alone or in combination as it is not possible to conceive to use the organic-inorganic hybrid polymer having a silicon compound capable of performing hydrolysis and polycondensation and the organometallic particle having a photopolymerization reactive group in combination, that a volume hologram having thereby a large refractive index modulation amount between a binder and a refractive index modulation component can be obtained, and further that the film physical property of the film obtained improves from any one of these references taken alone or in combination.

Even if one skilled in the art were to take the disclosures of Baney et al. and Krug et al. into account, it is submitted to not be possible to easily arrive at the volume hologram of the instant invention as claimed.

Thus, it is concluded that the photosensitive composition and a photosensitive medium of the present invention as defined in claims 13, 19 and 20 is not made obvious from the cited references.

Amended claims 25, 29, 33 and 34 of the present invention, set forth and claim the use for volume hologram recording and a method for preparing a volume hologram. Since the binder resin can be subjected to raising of its refractive index by utilizing a binder resin bonded to a metal, or by utilizing a binder resin having a hydroxyl group and/or carboxyl group in combination with a metal chelate compound having higher refractive index than a photopolymerization reactive compound, the refractive index modulation amount can be enlarged by utilizing the difference of the refractive indices between the binder resin endowed with a high refractive index and the polymer of the photopolymerization reactive compound.

In addition, the feature of the photosensitive composition of amended claims 25 and 29 of the present invention states that the binder resin can be subjected to raising of its refractive index by utilizing a binder resin whose average molecular weight is in a range of 1,000-10,000 bonded to a metal selected from the group consisting of Ti, Zr, Sn and In or by utilizing a binder resin containing a hydroxyl group and/or carboxyl group whose average molecular weight is in a range of 1,000-10,000 in combination with a metal chelate compound of a metal selected from the group consisting of Ti, Zr, Sn and In. Since an average molecular weight of the binder component is in a range of 1,000-10,000, the shift of the photopolymerization reactive compound, which is a refractive index modulating component, becomes active upon exposure, the separation from the photopolymerization reactive compound (monomer) is clearly performed, and a large refractive index modulation amount can finally be obtained in the volume hologram.

Also, the feature of the photosensitive composition of new claims 25 and 29 recites a multifunctional epoxy compound having a hydroxyl group or carboxyl group whose average molecular weight is in a range of 1,000-10,000 or a multifunctional epoxy compound having a

hydroxyl group or carboxyl group whose average molecular weight is in a range of 1,000-10,000 in combination with a metal chelate compound of a metal having higher refractive index than a photopolymerization reactive compound. Since the average molecular weight of the binder component is in a range of 1,000-10,000, the shift of the photopolymerization reactive compound, which is a refractive index modulating component, becomes active upon exposure. The separation from the photopolymerization reactive compound (monomer) is performed, and a large difference of refractive index can be obtained in the volume hologram. Furthermore, it is possible to obtain a volume hologram exhibiting excellent heat resistance and mechanical strength by thermally curing the epoxy group finally. An advantage of the epoxy compound is seen in the point of little shrinkage at the time when polymerization is performed.

Proskow '608 is cited under 35 USC 102(b) in paragraph 12 of the Action.

A composition comprising a low molecular weight (Mn ~ 3,400) liquid butadiene/acrylonitrile copolymer containing terminal and pendant carboxyl groups (3.24% carboxyl content), zinc acetylacetonate, 1,6-hexanediol diacrylate and benzil dimethyl ketal is disclosed in Example 4 of this reference. The carboxyl group may be neutralized by a metallic cation. However, there is not disclosed anywhere in this reference a use for volume hologram recording. For this reason, it is submitted that the objection must fall.

JP10-338850 is cited in paragraph 10 of the Action.

A composition comprising tetrahydrofurfuryl acrylate, γ-methacryloxpropyl trimethoxy silane, an epoxy compound (Epicoat EP 828), a radical photopolymerization initiator, a cationic photopolymerization initiator (onium salts) is disclosed. JP10-338850 is directed to a cementing material for glass-containing material. There is no hint or suggestion for the use of the

cementing material for volume hologram recording. Again, it is submitted that the objection to this reference must fall.

In the cited references listed below, a composition comprising a binder resin other than an epoxy compound having a hydroxyl group and/or carboxyl group, a silane coupling agent, a photopolymerization reactive compound, a photopolymerization initiator is disclosed. However, a use for volume hologram recording is not mentioned in any of the cited documents. Specifically, Paragraph 3; Nakamura et al. (JP05-346662); Paragraph. 4; Sashida et al. (US Pat. No. 5,648,451); Paragraph 7; Kikuchi (JP63-264686); Paragraph 8; JP06-161095; Paragraph 9; JP2000-273418; and Paragraph 11; Mochel et al. (US Pat. No. 3,758,306)

Sashida et al mentions that a molecular weight of a binder resin is 8,000 or 6,000 (see Comparative Example 4).

In Kikuchi, an aluminum coupling agent and a titanium coupling agent are used (Examples 2 and 3).

In JP06-161095, a light metal salt of an olefin-maleic-acid (K, Li, Na, Ca) is mentioned.

In Mochel et al., an aluminum chelate agent is mentioned (Example 1, col. 14, line 36).

Each photosensitive composition of claims 25 and 29 of the amended claim of the present invention is a photosensitive composition for volume hologram recording comprising a binder resin whose average molecular weight is in a range of 1,000-10,000 bonded to a metal selected from the group consisting of Ti, Zr, Sn and In or a binder resin having a hydroxyl group and/or carboxyl group whose average molecular weight is in a range of 1,000-10,000 and a metal chelate compound of a metal selected from the group consisting of Ti, Zr, Sn and In. The present

invention is different from Proskow on the point that the metal is selected from the group consisting of Ti, Zr, Sn and In.

Also, each photosensitive composition of new claims 25 and 29 of the amended claim set provides a photosensitive composition for volume hologram recording comprising a multifunctional epoxy compound having a hydroxyl group or carboxyl group whose average molecular weight is in a range of 1,000-10,000 or a multifunctional epoxy compound having a hydroxyl group or carboxyl group whose average molecular weight is in a range of 1,000-10,000 and a metal chelate compound of a metal having higher refractive index than a photopolymerization reactive compound. The present invention is different from Proskow on the point that the binder is a multifunctional epoxy compound.

The feature of the amended claims 33 and 34, the use for volume hologram recording and a method for preparing a volume hologram is that since the binder resin can be subjected to raising of its refractive index by utilizing a binder resin bonded to a metal, or by utilizing a binder resin having a hydroxyl group and/or carboxyl group in combination with a metal chelate compound having higher refractive index than a photopolymerization reactive compound, a refractive index modulation amount can be enlarged by utilizing the difference of the refractive indices between the binder resin endowed with a high refractive index and the polymer of the photopolymerization reactive compound when forming a volume hologram. This feature is noted not to be taught or suggested by Proskow.

Each photosensitive composition of claims 25 and 29 of the amended claim of the present invention is different from JP10-338850 because a metal is selected from the group consisting of

Ti, Zr, Sn and In, and a binder resin whose average molecular weight is in a range of 1,000-10,000 is used.

Each photosensitive composition of claims 25 and 29 of the amended claim of the present invention is distinguishable from Nakamura et al. in the sense that a metal is selected from the group consisting of Ti, Zr, Sn and In, and a binder resin whose average molecular weight is in a range of 1,000-10,000 is used.

Each photosensitive composition of claims 25 and 29 of the amended claim of the present invention is distinguishable from Sashida et al. because a metal is selected from the group consisting of Ti, Zr, Sn and In.

Each photosensitive composition of claims 25 and 29 of the amended claim of the present invention is distinguishable from Kikuchi because a binder resin whose average molecular weight is in a range of 1,000-10,000 is used.

The same photosensitive compositions of claims 25 and 29 is submitted to be distinguishable from JP10-338850 as the average molecular weight is in a range of 1,000-10,000, and a metal chelate compound of a metal having higher refractive index than a photopolymerization reactive compound is contained.

A similar reason holds true for the objection raised citing Nakamura et al. because a multifunctional epoxy compound has the average molecular weight in a range of 1,000-10,000, and a metal chelate compound of a metal having higher refractive index than a photopolymerization reactive compound is contained.

The claimed photosensitive compositions of claims 25 and 29 are distinguishable from Sashida et al. as a multifunctional epoxy compound is contained, and a metal chelate compound of a metal having higher refractive index than a photopolymerization reactive compound is contained.

These claims are distinguished from Kikuchi and JP06-161095 as a multifunctional epoxy compound has the average molecular weight in a range of 1,000-10,000.

JP2000-273418 is believed to be distinguished as a multifunctional epoxy compound having the average molecular weight in a range of 1,000-10,000, and a metal chelate compound of a metal having higher refractive index than a photopolymerization reactive compound is is claimed. This reference is deficient in this regard.

The photosensitive compositions of claims 25 and 29 are submitted to be distinguishable over Mochel et al. because a multifunctional epoxy compound has the average molecular weight in a range of 1,000-10,000 is set forth. This feature is not disclosed in the reference.

Amended claims 33 and 34 of the present invention, claim a volume hologram recording and a method for preparing a volume hologram wherein the binder resin can be subjected to raising of its refractive index by utilizing a binder resin bonded to a metal, or by utilizing a binder resin having a hydroxyl group and/or carboxyl group in combination with a metal chelate compound having higher refractive index than a photopolymerization reactive compound, a refractive index modulation amount can be increased by utilizing the difference of the refractive indices between the binder resin endowed with a high refractive index and the polymer of the photopolymerization reactive compound when forming a volume hologram. This feature is not disclosed or contemplated by the above cited documents.

In Paragraph No. 5, the Examiner rejected claims 29-34 over Kawabata et al. as it would have been obvious to modify the examples by using other disclosed polyfunctional monomers and additives such as the silane coupling agent.

Claims 29-34 are rejected in paragraph 6 as Kojima et al. discloses that adhesion to glass substrates improves by adding the silane coupling agent and would be obvious to one skilled in the art to add the silane coupling agent to gain increased adhesion to the glass substrate of the composition used in the examples of Kawabata et al.

Kawabata et al. (US Pat. No. 5,453,340) discloses a composition for volume hologram recording comprising a cationic polymerizable compound, a radical polymerizable compound, a radical photopolymerization initiator composition and a cationic photopolymerization initiator composition and spin coating the composition on a substrate are disclosed. Also, as the cationic polymerizable compound, a polyfunctional monomer having a hydroxyl group is disclosed (col. 3, line 60). It is mentioned that a silane coupling agent may be contained as an optional additive (col. 6, line 21).

Kojima et al. (US Pat. No. 4,842,968) discloses the addition of a silane coupling agent having ethylenically unsaturated double bonds to a composition for hologram recording medium (col. 4, lines 27-49).

The photosensitive composition of claim 29 of the present invention is a photosensitive composition for volume hologram recording comprising a binder resin having a hydroxyl group and/or carboxyl group whose average molecular weight is in a range of 1,000-10,000 in combination with a metal chelate compound of a metal selected from the group consisting of Ti, Zr, Sn and In, a photopolymerization reactive compound and a photopolymerization initiator.

The present invention is different from Kawabata et al. on the point that a metal is selected from the group consisting of Ti, Zr, Sn and In.

Also, the photosensitive composition of the amended claim 29 of the present invention is a photosensitive composition for volume hologram recording comprising a multifunctional epoxy compound having a hydroxyl group or carboxyl group whose average molecular weight is in a range of 1,000-10,000 in combination with a metal chelate compound of a metal having higher refractive index than a photopolymerization reactive compound, a photopolymerization reactive compound and a photopolymerization initiator. The present invention is different from Kawabata et al. on the point that a metal chelate compound of a metal having higher refractive index than a photopolymerization reactive compound is used.

Further, the amended claim 34 of the present invention, discloses the use for volume hologram recording and a method for preparing a volume hologram use a binder resin having a hydroxyl group and/or carboxyl group and a metal chelate compound of a metal having higher refractive index than a photopolymerization reactive compound. The present invention is different from Kawabata et al. on the point that a metal chelate compound of a metal having higher refractive index than a photopolymerization reactive compound is used.

The photosensitive composition of the subject application recites the use for volume hologram recording and a method for preparing a volume hologram wherein the binder resin can be subjected to raising of its refractive index by utilizing a binder resin having a hydroxyl group and/or carboxyl group in combination with a metal chelate compound having higher refractive index than a photopolymerization reactive compound, a refractive index modulation amount can be enlarged by utilizing the difference of the refractive indices between the binder resin endowed

with a high refractive index and the polymer of the photopolymerization reactive compound when forming a volume hologram. Hence, the feature that the binder resin is subjected to raising of its refractive index cannot be anticipated by Kawabata et al. describing a silane coupling agent as an optional additive and Kojima et al. describing the function of a silane coupling agent known to one skilled in the art wherein adhesion to glass substrates improves by adding the silane coupling agent.

For the reasons mentioned above, the present invention after amendment is submitted not to be anticipated or made obvious in view of the cited references. Favorable reconsideration is respectfully requested.

Respectfully Submitted,

Date: 9/27/04

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Date: September 27, 2004

Tanya Putnam